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ABSTRACT

This report is a summary of experience gained on international study tours and conferences about ways to increase young people's interest in science and technology and to change girls' attitudes towards technology by presenting the subject in a more interesting way. The document begins with some general thoughts about the significance of international contacts. Participation in three different conferences and the resulting network that developed are described. The distribution of men and women in technology in other countries indicates that it is possible to influence the choice of occupation, and that women are not necessarily inferior to men in technical occupations. In a world increasingly dependent on technology, where problems and solutions tend to be framed in technical terms, technology ought to be everybody's business. Yet statistics clearly show that university studies and professional engagement in science and technology are dominated by one gender. Most of the students at the institutes of technology in Sweden are men, even though the percentage of women has increased slowly since 1922, when they were first allowed to study there. This book discusses programs at universities in Australia, too, and the philosophy from which the idea of science centers has grown. By creating technological activity centers it is possible to increase young people's interest in science and technology. Finally there is a description of technology education in the Polish school system, with special emphasis on technology in the nursery schools in Poland. (Contains 23 references.)

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IMPORTANCE AND CONSEQUENCES OF INTERNATIONAL CONTACTS

INGRID GRANSTAM

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IMPORTANCE AND CONSEQUENCES OF INTERNATIONAL CONTACTS

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Department of Technology
Report No 7, 1991

JÖNKÖPING UNIVERSITY COLLEGE
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ABSTRACT

- -

Ingrid Granstam

IMPORTANCE AND CONSEQUENCES OF INTERNATIONAL CONTACTS

Report No 7, 1991 ISSN 0284-5911

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At the same time as this report stresses the importance of international contacts, it also has to be seen as a contribution to the debate on girls and technology.

An account of some international conferences and a record of visits to foreign universities and institutions are given. I have also discussed the opportunities, offered by science centers and scientific technological museums, to reach children and young people with interesting information about science and technology.

This report also describes the evolution of technology in Poland illustrated by examples of technology education in Polish nursery schools.

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Key-words:

Science, Technology, Girls, Technological information, International contacts, GASAT, Universities.

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THE IMPORTANCE AND CONSEQUENCES OF INTERNATIONAL CONTACTS

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INTRODUCTION

Thanks to my comprehensive study tours abroad and the international conferences I attended, I have been able to gather significant material about ways to increase young people's interest in science and technology. My favourite subject has been Girls and Technology and how to change girls' attitude towards technology by presenting the subject in a more interesting way.

The importance of international contacts has become more and more obvious to me, and therefore I wrote this report in an attempt to give a summary of my experiences. First there are some general thoughts about the significance of international contacts, then I will describe my participation in different 2conferences and the resulting network I gained from it. I will also tell about my study tours to some foreign universities and institutions and about the philosophy from which the idea of science centers has grown. By creating technological activity centers it is possible to increase young people's interest in science and technology.

Finally there is a description of technology education in the Polish schoolsystem, with special emphasis on technology in the nursery schools in Poland.

This report is a contribution to the debate on Girls and Technology, as well as an evidence of the importance of international contacts.

INTERNATIONAL CONTACTS AT UNIVERSITY LEVEL

Although Sweden is a rather small industrial country, it has always had an advanced position in the international technological world. Ever since the Second World War Sweden has been closer to the USA than to its European neighbours.

As the world increasingly depends on science and technology, Sweden must stay at the front of knowledge and research.

Unfortunately, language barriers are devastating for a more lively interchange between the different European countries. In general the English language is of no problem to Swedish university students, but other European languages like German, French and Spanish are more or less neglected.

By increasing communication and improving knowledge of languages, future international contacts can be made easier. Communication can be facilitated by international data processing and by the circulation of papers. The effect of the written word could be advantageously complemented by continuous, personal contacts. Therefore ways to establish personal contacts must be simplified.

We are all aware of the value of international student exchange. The advantage which university students derive from exchange is enormous. Also at minor university colleges a well organized activity should be created, thus facilitating for students to study brief courses abroad.

University lecturers and researchers must keep pace with the actual development and research findings. Here, personal contacts are an enormous advantage as they can enrich education and stimulate innovation. These personal contacts should be provided by an interchange of lecturers and researchers.

To participate in international conferences and to have the opportunity to make study tours to foreign universities is tremendously stimulating, especially when meeting lecturers and researchers in our own field. Afterwards, having gained experience with colleagues, the international contacts will

become profitable for the university as a whole. It is very useful for persons interested in similar problems to associate in international networks. In this way knowledge and proficiency in a particular field can quickly be spread to many countries, and our work at the Swedish universities can be substantially improved.

GASAT - HISTORY AND FUTURE
(GASAT, Gender And Science And Technology)

GASAT has evolved from an informal network to a worldwide international forum. Originally, it served as a support group for isolated researchers from industrial countries. Over the years, both the number and diversity of participants have increased.

In 1979 several researchers in Northern Europe met informally to discuss their work concerning the access of girls and women to careers in scientific and technological fields. As the issue crossed national boundaries and cultural differences, they proposed an international symposium, so that all men and women working in projects about girls and science and technology (hence the name GASAT) could meet, disseminate and discuss research findings and experiences.

In 1981 the first international forum, GASAT 1, was held at the Technische Hogeschool, Eindhoven. The following issues were discussed by participants from eight countries: teachers' training, support for girls and women, curricula and teaching material.

The GASAT 2 forum was held in 1983 in Hadeland, Norway. The 55 participants came from eight different countries and held discussions on sex stereotypes and interactions, curriculum, intervention programmes and teacher training.

Chelsey College, London, was the host institution for GASAT 3 in 1985. More than one hundred participants representing twenty different nations, including Australia and New Zealand, four African countries and three Eastern European countries attended. GASAT 3 focused on the research that evaluated the intervention projects which had occurred since the original GASAT forum.

In 1986 a regional conference was held in Elsinore, Denmark. It was called "The European Conference on Women, Natural Sciences and Technology." About one hundred participants came from sixteen countries.

GASAT 4, hosted by the University of Michigan in 1987, was attended by 156 participants from thirty-one different countries. Under the theme: "A Celebration of Diversity", attention was focused on the diversity of women, science, involvement and interaction.

GASAT 5 was held at the Technion-Israel Institute of Technology in Haifa, Israel in 1989. The purposes of this conference were to explore diverse aspects of gender differentiation, to examine policies which will help eliminate barriers to women's participation in scientific, engineering and technological fields and to improve women's prospects and position in the labour market.

On 6-11 May 1990 an intermediate-regional GASAT conference took place in Jönköping, Sweden. This Conference was called: "European and Third-World GASAT Conference" and emphasized the participation of both European and Third-World countries, but participants from all over the world were welcome. 130 participants from twenty countries came. With grants from for example SIDA and UNESCO, people from Kenya, Nigeria, Sierra Leone, India, Central America and Jordan could attend. The theme for the conference was "Science and Technology - a Future for All".

The framework for contributions for this conference was:

1. Girls and Women in Science and Technology Education from pre-school to the age of 16.

2. Girls and Women in Science and Technology Education from the age of sixteen in higher education and in adult education; formal and informal experiences.

3. Women in the Workplace : in Science and Technology, at all levels.

The conference programme included the following activities: overviews of papers, discussion groups, poster paper presentations, symposia, workshops, and informal discussions.

In April 1990 a preliminary national conference with the same theme "Science and Technology - a Future for All" was held in Jönköping. Svein Sjöberg, a GASAT member from the University of Oslo, opened the conference with a lecture entitled "Could Einstein have been a woman?".

Set up as a work-shop, the participants then worked on a programme-scheme for the coming "European and Third-World GASAT Conference".

By way of conclusion, Jan Harding, one of the guiding members for GASAT in Europe, gave a lecture on "Science and Technology, a Future for Women!".

To take part in GASAT means to become a member of an extended international network. GASAT-members interchange their findings of different projects and the results of their experiments on how to make science and technology more lifelike. The fact that GASAT conferences have evolved so quickly proves that an international forum is to be indispensable. The movement is driven by idealistic volunteers who accomplish time-consuming, extensive and hard work.

The GASAT conferences have only been possible thanks to generous sponsoring from local and central governments, organisations, universities and industries.

The steadily increasing number of participants in recent years is bound to lead to a choice between a big global GASAT forum or several small, delimited GASAT work-shops confined to specific areas of the world. Doubtlessly, both forms can

supply an existing demand. At the two last GASAT-conferences the formation of a GASAT Association has been discussed and recommendations have been given for the future.

International contacts are absolutely indispensable for Swedish universities and the GASAT movement offers excellent opportunities to get informed about scientific progress in other countries. It is very stimulating and enriching to meet interesting people and move in circles of foreign researchers. Via a network of people working in projects about girls and science and technology, research-findings and experiences can be disseminated so that we all learn from each another.

IMPRESSIONS FROM THE GASAT 4 CONFERENCE IN THE USA

For about ten years, I was the head of the project "Girls and Technology" at Linköping Institute of Technology. As one of the Swedish delegations to the 4th GASAT conference, we participated with this project in 1987 in Ann Arbor.

A conference of diversity and versatility

"As I see it, GASAT has evolved from an informal network to a sophisticated international forum. Originally, it served as a support group for isolated and, often, insulated researchers from industrial nations. As GASAT matured, both the number and diversity of participants increased as well as the breadth and sophistication of their papers."

With these words Jane Butler Kahle, professor at Purdue University, USA, and the international convenor opened the 4th GASAT Conference at Ann Arbor. The theme for the conference was: "A celebration of Diversity" and this diversity was applicable both to the contents of the conference and to the broad geographical origin of its participants.

Results of long-term research projects on sex-divergence in schools were shown and reports were given on information projects directed at girls.

Discussions were held on strategies to follow in order to increase girls' and women's interest in science and technology. The conference was a gathering of people from a widespread area of professions such as sociologists, psychologists, educationalists, administrators and representatives of the labour market authorities. They came from different corners of the world e.g. Africa, Asia, Australia, USA, Canada and Western-Europe. Indeed, very obvious proof of the forces at work all over the world to manage the obliquity of sex-division in education and work.

Realisation of the conference

Our huge programme offered a variety of workshops, film-sessions, seminars and group-discussions.

A couple of persons were responsible every day for the distribution to all delegates of the written contributions grouped in different fields. Included in this responsibility was the task to assemble the conference groups for discussions about important questions concerning the subject of the day. Discussions were held in small groups, concerning just one issue.

Each participant could freely choose the discussion group which corresponded best interest and preference.

In the Swedish group, we managed to attend many different discussions. The first discussion was extended over two working periods in order to enable the participants to get acquainted. The other days only one working period was daily allotted to group discussions. The last item on the daily programme was optional, giving participants the opportunity to visit the various workshops. The Swedish delegation contributed with a workshop about simple machine- and bridge-construction, showing how our project-group gives demonstrations in comprehensive schools.

Own contribution

A big interest was shown for our project and many participants attended our workshop. We showed how simple machinery becomes the instrument that can make heavy lifts easier for everybody.

Visitors to our workshop were amazed to see that the quite simple equipment, brought from Sweden, proved to be useful in such an extended field of application. During the experimental work of bridge-construction, participants were asked to build a

bridge with the help of paper, adhesive tape, glue and straws. First we showed some illustrations with different types of bridges and with various constructions. Accidents occurring to bridge-constructions were discussed and we showed a video-film on the breakdown of the Tacoma-bridge in the state of Washington, USA, in the year 1940.

After explaining to the participants how simple devices can strengthen ordinary paper, they could start their own bridge-construction. All bridges were load tested afterwards with books! Participants showing great interest in our project, were also given an English brochure about our project.

During a seminar, we gave an account of a study we made on girls' situations in relation to technical education and careers. The report is called a "Summary of a Survey of 135 Engineering Students at Linköping Institute of Technology". We discussed the setting and the target group of this survey. Our audience responded with many points of view and interesting suggestions regarding the formulation and results of our inquiry. For hours we discussed ways to get more girls interested in Science and Technology. We studied ways of making the graduate engineers' training more suitable for girls. Opinions differed of course, as much as there were listeners. The gist of the discussion was that girls who choose to study technology unfortunately still have a certain feeling of inferiority to male technologists in the matter of prerequisites for technical studies.

Examples of Science education

One of the many projects which are now going on in the USA is COMETS (Career-Oriented Modules to Explore Topics in Science).

The purpose of this project is to show pupils at compulsory schools that science is used in many different jobs and it is not at all restricted to research, medicine and engineering.

The project aims to increase the interest of girls in technology and to open their opportunities in various technical occupations. The project is based on the idea that it is important for pupils to learn and discover by their own experience and that girls' attitude towards science and technology can be influenced by giving them adequate female models.

For the use of teachers a voluminous guide has been compiled, giving a multitude of historical examples of women and men achieving greatly in science and technology.

Tips are given how various occupational fields can be made lifelike in the class-room, e.g. in mechanical engineering and in chemistry. A very important part of the programme is the use of a local "asset-person" who is invited to the school to report on his or her job.

The idea of the project has been spread by theme-days for teachers and has reached different municipalities in some 20 states. Evaluation shows that the efforts have been fruitful.

Girls and Computer Science

Considering the many different countries and cultures of the participants, the basic starting point varied a great deal. It is a common phenomenon in Western countries that very few girls take an interest in computer science. But this science, being a new field, should not have been "saddled" with the predetermination to be a male territory!

In the USA e.g., various organisations are committed to information-campaigns directed at girls. A number of research projects aim to delineate the reasons for girls' minor interest in computer science. Is the lack of interest due to the girls or to the computer science?

Responsibility for technology development

Do women in the industrialized world have a responsibility for the development of technology and its effects on social evolution in the third world countries? Are they consequently responsible for the women in those countries? Many participants, and not only those coming from the third world countries, were of this opinion!

Special fields

According to the wishes of many participants, special discussion groups were formed outside the normal programme setting to focus on a particular item of interest.

One afternoon we tackled the problem of how technology can improve and even save our environment. The theme of the discussion was: "Technology and life on earth". This vitally important issue was a point of consideration for many participants. To begin with, each and every one submitted a proposal on which he or she would like to concentrate his or her efforts to save the environment. We had a lively discussion about how to work out the different proposals in practical life. Suggestions ranged from stopping the use of disposable packaging to adopting the heat of the body as an auxiliary energy source in houses.

Those discussions told us that pollution is a world-wide problem and that protection of the environment has no global solution. As some solutions can be beneficial only to certain countries and not function at all for others, they have to strike root in every nation first!

Contact-network

Besides a very broad network, even smaller nets were established: a gathering of people with a common interest in

for example the curriculum of technology in schools, engineering education, classroom research, all items with a special emphasis on increasing girls' interest in technology. In each group a contact-person was selected. This person was commissioned to circulate and spread available information to all the members of the contact group.

THE SCIENCE CENTER IDEA

In North America there are a large number of scientific museums called Science Centers. These museums do not consist of a collection of historical objects but can be said to be activity centers where the aim is to interest people of all ages in science and technology.

Children seem to like these Science Centers very much. They learn the basics of science while they play and experiment. Older people always find something to interest them too. Besides trying themselves to find out how, for example, mirrors, prisms or wave machines work they can attend demonstrations of such subjects as electricity, chemistry, the anatomy of the body etc. The demonstrations are often given by very enthusiastic and knowledgeable students on whom children can model themselves. It is perhaps particularly important that girls may meet female scientists as demonstrators and researchers.

There is also a planetarium at several Science Centers where exciting space shows can be seen. There might also be an aquarium or a zoological department where different sorts of animals can be viewed. In some departments it is possible to test one's knowledge by answering questions and pressing different answer buttons.

Some of the most appreciated museums really challenge the visitor to think creatively. For example, that is how the Exploratorium has become one of San Francisco's attractions and also a model and an example for different scientific museums in the whole world. Here science is really illustrated for children and young people in such an interesting way that they can quite soon be expected to see the beauty of it.

The old Chinese proverb:
- I hear and I forget
- I see and I remember
- I do and I understand

is often quoted at different Science Centers.

Children learn in an unconventional way important facts about science and technology. They may experience a fascinating environment at the same time as they meet well educated male and female scientists who are willing to help them. It is essential to boost the children's self confidence as regards science and technology. Sometimes one of the pupils in a school class at the Exploratorium is chosen to present different experiments to his/her friends. The pupil then has to play the role of model while he or she at the same time acquires useful knowledge about science or technology. Teachers visiting this center, or many other centers, can get help from the museum staff to prepare different experiments. In that way the museum's equipment is used and it is possible to benefit from the museum's means of illustrating different scientific phenomena at the same time as the activities are related to classroom teaching.

It is quite common that museums are involved in special programs and courses. Schoolpupils with special interests and other groups of people can, for instance, learn to program computers or do chemical analyses. They can also make observations in, for example, meteorology or biology in supervised excursions. In America there is, as in most West European countries, a great need to, among other things, get schoolteachers at primary and secondary level more interested and knowledgeable in science and technology. A great deal of help is required since a lot of teachers feel that they are most inadequate. Science Centers can be extremely useful by supporting and helping teachers in their schoolteaching and offering school-related programs at the museum while they also make science and technology interesting to both children and adults.

There can be many different types of Science Centers. Despite the fact that the underlying philosophy is the same and distinguishes them from the traditional museums no two Science Centers are alike. The fundamental idea of the Science Center is that it is fun to learn about science and technology and medicine and that the most effective way of learning is to actively experiment and test.

A great deal of the slightly older, large, widely aimed and developed Science centers are very expensive establishments with many employees and a large budget. Otherwise the trend is towards smaller Science Centers. Even in the U.S.A. it is thought that large establishments cost too much to run and nowadays a network of small or medium-sized centers are being built in several different places in North America and also in other parts of the world.

At the Technical Museum in Stockholm, for example, there is a department called Teknorama which is well worth a visit. And in Luleå we find "Technology's House", a paradise for curious, inquisitive and imaginitive "children" of all ages. Such technical activity centers have also been established in other places in our country.

CONASTA - A WORLD CONFERENCE IN AUSTRALIA

During the summer of 1988 I had the opportunity to attend the Conasta World Conference in Canberra, Australia. I contributed my own report on "Girls and Women in Science and Technology Education".

The conference was hosted by ASTA (Australian Science Teachers Association). Theme of the conference was "Science Education and the Quality of Life: a World Issue", and it treated science and technology education in various countries.

The two main points were: how technology education had to be drawn up to be enjoyable for students, and how the education could arouse a consciousness for how to use technology.

The message was clear: there is only one earth. Our science and technology knowledge and proficiency should be used to preserve it, not to destroy it!

The conference was from 3 to 8 July 1988. Participants from the four corners of the world arrived at Canberra, though most of them came from the different Australian states.

Some participants came to give lectures and organize workshops, whilst others just assisted as an interested audience. The programme setting was interlarded with various activities. Some days general lectures were held, on other days it was difficult to choose between the large selection of various lectures.

The two introductory lectures focused on the interplay between biology and technology.

During the week, workshops were arranged by teachers from different countries, which gave us the opportunity to get acquainted with the educational system of technology in the different countries.

The very first day, I gave a lecture for an international audience. I was also given the opportunity to display my exhibition on "Girls and Technology Project at Linköping Institute of Technology". I also gave a second lecture and took care of the poster - exhibition. The interest for my theme was great. My second lecture attracted such a big audience that people were forced to stand and even sit on the floor. This interest was enormously stimulating. It also gave me the chance to establish new contacts with people from all over the world.

The conference took place at "The Australian National University" in Canberra and the campus was very large. Canberra counts ca 250.000 inhabitants and is a fascinating town, projected as late as 1920.

Our host country invited us to a grand dinner in the brand-new House of Parliament. This public building as well as many other in Canberra, was a real exhibition of modern architecture. To me, this town felt rather sterile and unreal, a kind of compromise to the "tug-of-war" between Sydney and Melbourne in earlier days for the hegemony of Australia. There is no resemblance whatever with any other city. Complete symmetri is the predominating picture Canberra offers and slum districts are non-existing. Most of the inhabitants are either employed by government or have customary service jobs.

Excerpts from some lectures at the conference:

The first lecture was given by Dr David Suzuki, professor at the "Department of Zoology", University of British Colombia, Vancouver, Canada. This was a very interesting dissertation about the achievements of science and technology for mankind, more specific its significance for medicine, our tangible assets and the economic rate of growth. According to Dr Suzuki all this contributed to reach today's high standard of living. Message though his lecture was that everything has a price! Our current consumption has consequences that cannot be foreseen yet. Many of the already known problems have a global

character: the damage by reckless cutting of the forests, the extinction of animal species, the disturbance of the ecological system, pollution, overpopulation of certain regions, the spreading the deserts etc. ..

Dr Suzuki means that problems often arise because different nations do not agree on the measures to be taken. Actions cost money, and countries generally blame each other. A similar pattern of behaviour can be seen inside the countries: various political sections and different departments put the blame on each other and in the end no action at all is taken. Due to short-range surveys of the situation, people do not realise that the today's welfare could result in a state of disaster within a 100 years!

The title of Dr Suzuki's lecture was: "The 21st Century - A Challenge for the Present". Time has now come to set about the problems. If the present generation can not decide about the environment today, no nature will be left for the succeeding generations.

The sole solution lays in stopping the rampant development and in educating the public. According to Dr Suzuki, it is very important that the current squander becomes part of the public consciousness. Every individual must assume his responsibility for the environment. Simple things like buying primary products or contributing to recycling are a start to a more nature-minded way of living.

Just because we invented technology does not mean that we also can control it, says Dr Suzuki. We have to educate our children to critical human beings, able to distinguish between good and evil! The main danger slumbers is the scientific illiteracy of both children and adults. According to Dr Suzuki at least one hour of science education should be given daily in all schools. Only then we have a chance to implant a nature consciousness in our children at the same time as we can give them an insight into the best way of using technology. Dr Suzuki closed his very interesting and frightening lecture in quoting as follows: "When you spit upon the earth you spit upon yourself". A

request to all of us to collaborate for both nature's and our own survival.

Another interesting and frightening theme: "The Medical Consequences of the Nuclear Age" was taken up by Dr Helen Caldicott, former chairman of "Physicians for social responsibility" from NSW, Australia. Her lecture informed us about the possible effects of the exploitation of atomic energy on humanity. She explained about the various medical consequences of the uranium-mining, dressing-plants and energy exploitation. We were told about the risks of a nuclear war and its likely effects on life on earth.

Education of all our fellow-beings has become a must. Everybody has to know about the risks involved during the different handling phases of nuclear energy, starting with the Uranium-mining to the final storage. Every single individual has to learn how contacts with existing radiation-sources can be minimized.

According to Dr Caldicott 70-75% of the children have lost all faith in the future. Children are able to understand far more from politics and nuclear weapons than adults assume. We have to make children see that they still can influence the future by committing to politics and by learning people about the actual madness.

An additional, interesting lecture was held by professor Richard Whitfield, College of Art and Technology, England. He is afraid that even our social environment is endangered. Parents no longer seem to bother about their children and their progress at school. It is completely wrong to force school to take over more and more of the responsibility which parents have to assume. He emphasized that the only way to "save" the children is cooperation between teachers and parents. There is also a need for nature-oriented educators who can balance the school-subjects. Unfortunately, too much is handed over to politicians.

It is of tremendous importance that nature and the social environment are kept in balance, says Professor Whitfield. If

upbringing and education function as they should, they bring forth devoted, harmonious and independent individuals. Otherwise, we run the risk of transmitting to future generations a loveless and problematic education. To avoid being captured in a vicious circle, we first of all have to understand ourselves. We must learn to apprehend our own social behaviour and by studying nature we come closer to understanding ourselves. In order to live harmoniously we need a balance between all social and scientific subjects in education concluded Professor Whitfield.

Dr James Barufaldi, professor at the "Science Education Centre", University of Texas, discussed the role of natural science/technology education at the lower level of compulsory school. He presented his research results of "Hands-on science" in schools. This method implies pupil-centred activities in natural sciences/technology, where the teacher has an assisting role with only few examples for demonstration and fewer teacher-centred discussions. Hands-on science is in other words an investigating method of education. By this method pupils' feeling for language and their reading capability are improved. Professor Barufaldi found out that this method:

- improves the ability to listen and to express one-self
- integrates speech development and logic thinking of children coming from various socio-economic strata - on condition that education starts at an early stage
- promotes reading ability
- favours the power of apprehension
- ameliorates the study-technique
- fortifies the verbal capacity

This method also gives an alternative strategy to poor readers since the main attention lies on the activity and reading only comes afterwards. Many students get a better capacity to study, says Dr Barufaldi, and especially children from lower socio-economic strata show considerable success.

"Hands-on" lessons contribute to better understanding of natural sciences and technology and pupils seem to benefit more from the lessons expounded than from traditional lessons.

Attitudes towards science and technology improve remarkably and children seem to like this educational method. Their creativity increases considerably with this "hands-on-science" method.

Dr Margaret Mac Vicar, MIT, USA, talked about the advantage of everyday-knowledge of science and technology for everybody and how important it is that everybody understands why such knowledge is necessary. She gave some examples of disastrous consequences due to bad planning and inferior quality of technology. As soon as people get a better knowledge and understanding of technology, they will be able to protest against carelessness whenever it occurs, thinks Dr Margaret Mac Vicar.

One of the examples she mentioned was American cars. She herself was driving one of these completely electrically operated cars. When something broke down and she needed a tool from the boot, she was unable to open it because even that mechanism was electrically controlled!

Dr Margaret Mac Vicar lost two of her students in the "Challenger-disaster". Although scientists knew that something was wrong, Challenger took off all the same. The shuttle was cleared by technicians lacking the technical competence to grasp the connection of minor deficiences.

Dr Margaret Mac Vicar also told us about the crisis in the American society, for example the large part of scientifically illiterate people in the USA. Schools have big problems due to lack of money and the difficult working conditions for teachers.

Dr Mac Vicars lecture about the general situation in the USA ended in a lively discussion on changements needed in the educational system.

Suggestions made were based on the situation in the various countries of the participants. There is a brisk demand for more time for a creative training in smaller classes and for less lectures from the teacher's desk.

The lecturing part of the conference was finished off by a panel discussion on what science and technology education would look like by the year 2000. It was emphasized that science and technology education should be made available to all children and at all levels. In a suitable technology for both mankind and nature, there must be a connection between the theory and the practice. And last but not least, girls should be made more interested in technology.

The fact was stressed that only about 8 % of all students at institutes of technology in Australia are girls! One of the first things to do is to aim at a changement in attitude towards technology. A good science and technology education was said to take place not only in laboratories but also out in the free nature and inwards in teachers' and pupils' minds.

To sum up, it can be said that this conference yielded lots of facts and different points of view on technology education. In comparison with many other countries, it seems to me that Sweden is well on its way, both in education and attitudes.

CONTACTS WITH UNESCO

After the conference, I was invited to attend a UNESCO-meeting. During two days I got the opportunity to renew my contact with Sheila Haggis, Unesco's chief of Science Education Section in Paris at that time. I also had the opportunity handing over my poster-display to Unesco. They were interested in it, due to the fact that I have contributed to a book which published by Unesco: "Innovations in Science and Technology Education". We are grateful for Unesco's support to our Swedish GASAT conference in May 1990: "European and Third-World GASAT Conference". Unesco enabled us to invite to Sweden four more delegates from third world countries, beside the delegates supported by SIDA (Swedish International Development Authority).

VISITS TO UNIVERSITIES IN MELBOURNE AND AUCKLAND

During my trip to the Conasta World-conference in Canberra in 1988, I also visited Melbourne in Australia and Auckland in New Zealand.

At the request of a GASAT member, Kerrie Mullins-Gunst, I gave a lecture on "Women in technology" at the Swinburne Institute of Technology at Melbourne. The Swinburne Institute is a technical institute, similar to the Linköping Institute of Technology in Sweden. The audience for my lecture consisted of something forty university teachers and professors.

Kerrie Mullins-Gunst, is the manager of the Science Shop which is located on the edge of Swinburne's campus in Burwood Road, Hawthorn. One of the major activities undertaken by the Science Shop includes the identification of the scientific and technical basis of community problems. The motto is "Linking Science, engineering and technology with the community".

At the University of Auckland in New Zealand I met two other GASAT-members, Barbara Reilly and Margaret Morton. Even here I gave a lecture for university teachers and talked about our efforts to increase girls interest in technical education. The lecture was followed by a lively discussion. In the evening I was invited to a more informal gathering at professor Ivan Reilly's home. The same day, I also visited a science center in Auckland, which was of special interest to me because of their activities for youths.

Approximately 14000 students are enrolled at the University of Auckland which is the largest university of New Zealand. The university opened in 1883 as Auckland University College, part of the University of New Zealand, and did not become independent until 1962. The college began with four professors and 95 students, in a former courthouse and jail on the cliffs above Beach Road. Today the main campus has more than a score of major buildings, extends over four city blocks, and covers about forty acres.

OECD-CONFERENCE

In April 1989 I attended an OECD-conference in Orlando, Florida. The theme for the conference was "Science, Technology and Mathematics Education". This conference could be seen as a planning conference for a larger international OECD-conference, which was in Paris, March 1990.

In Orlando twenty-four participants from OECD countries in Europe, USA and Australia were invited to discuss the issue. The necessary background material was sent in advance to all participants so that a preliminary discussion basis was already at hand at the first meeting.

Every day we discussed one or two new questions:

- Goals of Science, Technology and Mathematics Education.
- Who are the students and what are their characteristics?
- What do we want them to learn?
- What are the appropriate settings and methods?
- What types of teachers are needed and what are the implications for training and career?
- Assessment and evaluation of student learning.
- Future stages of the project.

It was very interesting to participate in those discussions. In the various OECD countries there is a great disparity in all educational matters, e.g. educational planning trend, curricula, school-standards etc.

In more ways than one the Swedish school system is unique, for instance, the application of the same curriculum throughout the country, the equal valuation of different education, regardless where it was given. Our upper secondary school system with its more or less fixed choice of subjects differs from the system adopted in most of the other countries. We also discussed the Swedish system of giving marks only at a higher level.

Later it was the task of a minor working team, consisting of some participants of the conference at Orlando, to submit a program for the Paris conference in 1990.

Host for the conference in Florida was David Thomas, OECD, Paris. Paul J Block, London, and Myron J. Atkin, Stanford, prepared all the discussion topics.

TECHNOLOGY IN POLISH EDUCATION

Trying to analyse the problems and obstacles arousing when recruiting women for technology education, I found out that our neighbouring country, Poland, already had made some interesting progress in this particular field. Poland being a country of the Eastern bloc, the educational system obviously differs quite a lot from our Swedish system.

As early as at pre-school, efforts are made in various ways to interest children in technology. Technology is then a compulsory subject for all pupils at every level of instruction.

It is interesting to note that in the Polish educational system pupils who are particularly gifted in mathematics, physics or technology get special support, irrespective of sex. These, specially-gifted pupils are, on the advice of the school principal, rather often separated in special classes in the upper level of the compulsory school. It is also worth nothing from a pedagogical viewpoint, that serious efforts have been made for special training of teachers of technology.

Teachers of technology, from intermediate level and upwards, are now given training courses in technology at special faculties of engineering at universities. In Polish pedagogy the tuition of pupils seems to be closely controlled. Varying systems of reward and feedback mechanisms impel the development in the direction authorities have recommended, in this case, towards increased concentration on technology for both sexes. Since the second world war determined efforts have been made regarding women in technology.

At that time very few women were studying at institutes of technology in Poland (< 5% of the students of technology were female). Women's role in Polish society changed after the second world war. Women made heavy demands upon eqality with men. Certainly, the question of equality between sexes was already on discussion at the end of the 19th century, but now

the debate was becoming much more constructive. Polish women were interested in getting influence on every single aspect of their society and they wanted to be able to work in every field.

Strong women's organisation influenced even the Polish Government and nowadays skilled women are working in most of the occupational branches. In 1982, 75 % of Poland's women were working outside their home. As most of the socialistic countries, Poland was very much aware of the significant role women can play in society and wanted to take advantage of their commitment to the various fields. Though, after a few years, it became evident that it was not enough to accept that women had a role to play in a male-dominated world, e.g. in technology. Efforts had to be made to make it easier for girls to enrol in technology education and long-established but old-fashioned attitudes regarding women and technology had to be changed.

Around 1950, young people and particularly girls were consciously sought to take an interest in technology. Many held the view that women were less talented than men and less interested in science and technology. But psychologist emphasized that this difference was due only to a different upbringing and to social environment.

At certain faculties with low female enrolment quotas were allocated, giving extra points to girls willing to apply for technology, medicine and law.

Teachers were given further training in technical applications, courses were arranged and a lively debate was started on the positive role of technology in society. It was particularly emphasized, that teachers should feel enthusiastic about technology and that they should be capable of giving pedagogically based instruction on it.

Gradually, quite a number of women could be found in all

earlier typical male fields. In some educational lines the development was so positive that the number of female students growed rapidly. This, for instance, was the case in medicine where the paradoxical situation occurred that girls outnumbered boys. During the academic year 1979/80, 63 % girls were enroled in the faculty of medicine. After that, extra points were given to boys when they enrolled in medicine!

In 1982, 71 % of the pupils of upper secondary schools were girls and 29 % were boys. This low percentage of boys was due to the fact that most of the boys first wanted to learn a profession at a vocational school and possibly later on would resume further education. In spite of huge support, the number of girls enroled in technology education was still far from sufficient by the end of the sixties. Then it was decided to plan on the long term by trying to getting girls interested in technology as early as at pre-school and to continue the technical schooling throughout comprehensive school.

In 1978 approx. 28 % of the students at technological upper secondary schools were girls, at the 2-year-programme at institutes of technology 45 % of the students were female and girls made up 38 % of the 4,5-year-programme. At later programme, approx 25 % of the students who graduated in 1978 were girls (the average for all of the engineering course programmes) more girls than boys dropped out before getting a degree, especially at the 4,5-year-programme. The main reason for this seems to be that girls get married and have children and consequently have a difficulty in keeping up with their studies because they take the greatest responsibility for the family and the daily life. In Poland, for instance, you have to spend a lot of time queuing to buy food and everyday articles and this makes it very difficult to combine studies with a family.

The conclusion that can be drawn is that the concentration on technology in the Polish educational system has increased girls' interest in technology to a considerable extent and that nany now enrol in technical course programmes.

Everything points to getting a more equal allotment amongst men and women in technical education even in Sweden if we shall assume greater concentration on technology at all school-levels. If we want more girls working in various technical occupations we have to arouse, increase and actively encourage their interest in technology from a very early age and through all school-levels.

EXAMPLE OF TECHNOLOGY EDUCATION IN POLISH NURSERY SCHOOLS.

In Poland, various efforts are made as early as at pre-school to interest children in technology, attaching special interest to girls. Suitable educational toys are used, e.g. wooden or plastic blocks, which are cubic, parallelepiped or pyramidal. The children can use them to build towers, houses and streets. If necessary, teachers intervene to show the children the right way of building. Children can also investigate how planks rest upon different kinds of support, how to build model seesaws and how blocks slide on surfaces of varying steepness.

When the children play with mechanical and electrical toys, the teacher explains to them how everything works. She (teachers in nursery schools and at junior level of the compulsory school are almost always women in Poland) often guides the children's observations and shows them how, for example, batteries are used in various kinds of torch. If a child is not interested she tries to arouse the child's interest. She aims particularly to get the girls interested in technical toys. They can install lighting into a doll's house, make doll's furniture, assemble small bells etc.

Various kinds of educational puzzles are also often used in nursery schools. The teacher tells the children about different forms of energy, how coal is mined and where oil comes from. Small models are used to show how windpower can be harnessed. Then it is discussed with the children what happens when the wind blows, why it thunders, why rainbows, fog and dew form. Various physical phenomena such as magnetism, sound and echo effects, magnification with lenses and mirror effects are studied and knowledge about them is introduced in an amusing way into the children's consciousness. Dissolving sugar or salt in water are examples of simple chemical experiments for the children. Through practice the children's ability to estimate distances to various objects is developed.

Already in the nursery school, children should be able to recognize and draw circles, squares, rectangles and triangles. Both girls and boys must be able to use a large variety of tools, such as screwdrivers, hammers and tongs. They must learn how to vacuum clean and how to wash their clothes in a washing machine. Great importance is attached to explaining how to use electrical devices safely.

Visits to farms give the children the opportunity to familiarize with agricultural machines which simplify the farmers' work. In this way children early become aware of their surrounding and learn to understand alterations in the environment.

Quite often parents are invited to come both to the nursery schools and to the junior level of the compulsory schools to talk about their jobs. Preference is often given to parents with somewhat unusual occupations, for example to women in technical professions.

In many different ways teachers are thus trying to stimulate the children and to interest them in technical activities. Since it is known that boys have been much more interested than girls in technical things, special efforts are made to arouse curiosity and interest in the girls. This influence is carefully thought out and is reckoned to produce results in the long term. Nowadays many more women are engaged in technical studies and professions than twenty or thirty years ago.

The fact that even women are getting an early practice in technology in Poland will probably improve their chances of holding their own position in the technical sector.

DISCUSSION

Taking part in international conferences and visiting foreign museums and universities is of great value. Especially meeting people interested in one's own subject field is really valuable. People, from different countries and with various cultural backgrounds but, interested in similar problems should associate in international networks to discuss important questions.

There is a great demand for an international forum able to tackle the questions at issue regarding girls and technology and regarding the ways to make technology lifelike to children and young people. By studying how other countries teach technology, the Swedish schoolsystem can be provided with lots of new and bright ideas.

The distribution of men and women in technology in other countries indicates that it is possible to influence the choice of occupation and that women are not necessarily inferior to men in technical occupations. In Poland, for example, efforts to interest girls in technical subjects and in higher education at institutes of technology have turned out well. At a very early stage - as early as nursery school age - age-related instruction in technology has been successfully introduced. Technology is subsequently a compulsory subject for all pupils at every level of education. The efforts made in Poland getting girls interested in technology and in further education at institutes of technology have been successful and are of interest even for us in Sweden. Technology affects our daily life and our vision of the future more profoundly than at any previous stage of history. In a world increasingly dependent on technology, where problems and solutions tend to be framed in technical terms, technology ought to be everybody's business. Yet statistics clearly show that university studies and professional engagement in science and technology are dominated by one gender. And this is more or less true in most countries.

Being interested in technology is traditionally seen as quite masculine. Most of the students at the institutes of technology in Sweden are men, even though the percentage of women has

slowly increased since 1922, when they were first allowed to study there.

It has sometimes been said in the West European press that our age can be characterized as anti-intellectual. This has also affected attitudes to technical subjects. Fear of technical development sometimes shows in a contempt for technology and this tends to be more common in women than in men. Many problems in our society must be solved with a technique, that is somewhat different in its social orientation.

By international contacts we can learn from other countries about successfull efforts to increase the interest in science and technology for both girls and boys.

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